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<Symposium Overview: Presentations' outlines>GIS Thematic Mapping as an Instrument of Analysis for Identifying Rural Areas in Complex Territories

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CITATION:

P. GALVÃO, Roberta Fontan ...[et al]. <Symposium Overview: Presentations' outlines>GIS Thematic Mapping as an Instrument of Analysis for Identifying Rural Areas in Complex Territories. CIRAS discussion paper No.81 : Architectural and Planning Cu ...

ISSUE DATE:

2018-03

URL:

https://doi.org/10.14989/CIRASDP_81_116

RIGHT:

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GIS Thematic Mapping as an Instrument of Analysis for Identifying Rural Areas in Complex Territories

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Abstract

Currently, new economic and population dynamics formed in metropolitan areas – such as the case of the Macrometrópole Paulista (MMP), “macro-metropolitan region of São Paulo” – have established territorial, socio-economic and environmental transformations that impact urban and rural spaces.

Over the years, the productive activities in this enormous network of cities – the MMP – has gone through important physical and functional changes in which many activities lost their regional economic importance as can be seen in the decrease of population engaged in agricultural activities of rural areas. In this context, spaces have become quite heterogeneous, where the highly developed agro-industry exists alongside low-density areas with local agricultural production that does not participate in larger production chains. This diversity in the MMP makes it difficult to define and distinguish between rural and urban spaces, and requires new cartography resources capable of adjusting to and representing such phenomena in which the boundaries between these spaces can be definitively settled.

The Brazilian official territorial classification adopted by the Brazilian Institute of Geography and Statistics (IBGE) is based on an administrative definition of district and urban perimeter. The lack of a single national criterion in Brazil has resulted in arbitrary boundaries of rural and urban spaces.

This article aims to present the differences between the current Brazilian classification of urban and rural spaces with the research findings in “The rural in the São Paulo urbanization in a macro-metropolitan context”, beginning with an exploration of the concept of rural and the variables that characterize these areas.

Research has shown that in order to grasp the different aspects of the land it is necessary to find tools that can combine and integrate immense volumes of data on different scales and that came from various sources. The multivariate analysis of data associated with Geographic Information System (GIS) tools consists of a powerful set of instruments that can enhance the representations and analyzes so that further research can be developed on rural and urban boundaries in the context of intense urbanization. The cartography tools, presented in this article as a territorial feature on different scales and with varied complexity, allow research on public policies’ definitions and also as a way of disseminating the results and its applicability through the use of GIS in the digital environment.

Keywords: rural areas; metropolitan region; São Paulo; GIS tools.

Introduction

The definition of the term rural involves many different points of view and depends on economic, social, and cultural contexts, among other issues.

Most authors understand that the concept of rural is associated with the presence of agricultural and livestock production in a given region; low density populations, and the predominance of natural landscapes.

However, in the context of intense urbanization, the last few decades have shown that technological transformations, especially concerning transport and communications, will no longer admit that these parameters are sufficient to define rural spaces.

The rural spaces have become heterogeneous in terms of the activities developed in them and the commuting movements of its population, intensifying the relationship between city and countryside. The great diversity seen in these spaces made it difficult to distinguish between rural and urban spaces, imposing on cartography the challenge of finding resources that are capable of accurately representing such phenomena. Furthermore, it is necessary to consider new economic and commerce

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development in and between territories, both urban and rural, in order to reassess variables and parameters which are the criteria taken into consideration during the process of defining rural and urban areas.

Since the mid-1960s, Brazil has become a predominantly urban nation mainly due to the migratory movements from the countryside to the city stimulated by employment opportunities. Above Fig. 1 shows demographic evolution and the points at which this change occurs.

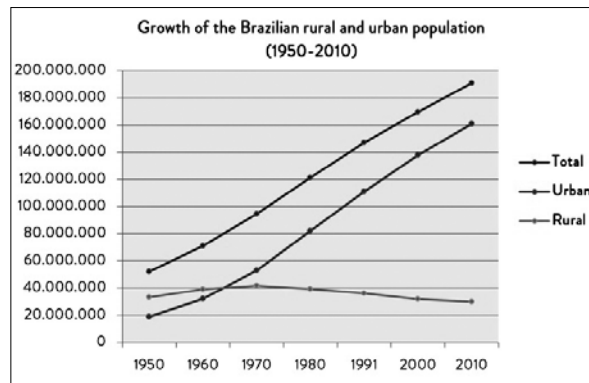


Fig.1. Growth of the Brazilian rural and urban population

How the division of land into rural and urban spaces in Brazil's case is defined adopts the following logic. There are no national criterion to how city management defines district and urban perimeters and in general it is intimately related to financial benefits these definitions may incur. This division is also used to classify households in official Brazilian surveys and is adopted by the Brazilian Institute of Geography and Statistics (IBGE). The problem with this classification is that it is based on a definition of "city" as the head office of a municipality and it was established in a 1938 law. In addition, the municipality defines their official limits between urban and rural areas through the Urban Perimeter Law or its Master Plans according to different criteria and based on the interests of each locality.

Therefore, this article aims to present the differences in the current Brazilian classification of "urban" and "rural" spaces with the results found in the doctoral research entitled "The rural in São Paulo urbanization in a macro-metropolitan context". It considers the boundaries for rural and urban areas as concepts under construction because of their constant transformation and because it requires multiple lenses – spatial, demographic, socioeconomic, cultural and environmental – which are encompassed in space and time.

metropolises, a fact which, to a certain extent,

has contributed to the development of some rural areas.

The Macrometropolitan Region of São Paulo is the large territory situated in the eastern region of the state of São Paulo. It is composed of 174 municipalities and it was established as a result of important economic and demographic dynamics that occur throughout the five (5) metropolitan regions in São Paulo State: the São Paulo Metropolitan Region (RMSP); Campinas Metropolitan Region (RMC); Baixada Santista Metropolitan Region (RMB); Vale do Paraíba e Litoral Norte Metropolitan Region (MRVPLN) and Sorocaba Metropolitan Region (RMS). There are still two (2) relevant urban agglomerations (Jundiaí e Piracicaba) and one (1) regional unit (Bragantina)¹, as can be seen in Fig. 1 below.

The MMP is 53,000 km² in area and there are approximately 31 million people living in this region according to the Brazilian Institute of Geography and Statistics (2010). It corresponds to approximately 75% of São Paulo State's population. The demographic density of the region varies between 7.33 hab./km² (in the São José do Barreiro municipality) and 13,534.82 hab./km² (in the Taboão da Serra municipality). Moreover, it concentrates about 83.7% of the State of São Paulo's Gross Domestic Product (GDP).

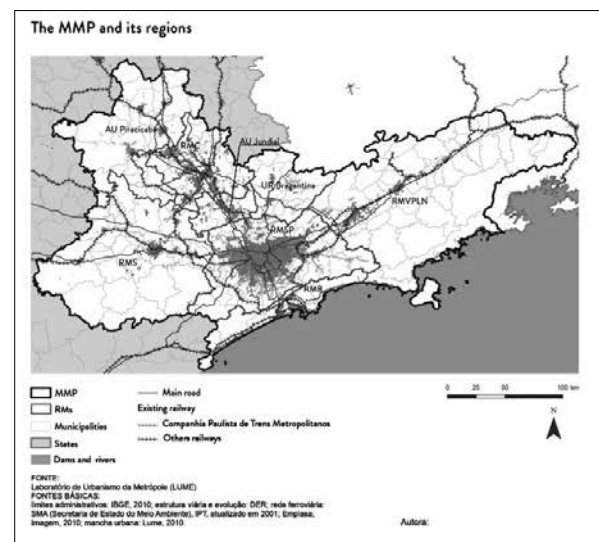


Fig.2. The MMP and its regions

New economic and population dynamics produced in metropolitan areas – such as the case of the Macrometropole Paulista (MMP) – impose ter-

1. The state of São Paulo has in its territory: metropolitan regions, urban agglomerations and regional units that have been defined by state laws.

ritorial, socio-economic and environmental transformations that impact urban and rural spaces.

Over the years, the production activities in this enormous network of cities underwent important geographical and functional changes in which many activities lost its regional economic importance. This can be observed in rural areas where beginning in the 1970's, the Brazilian government gave industrial companies, incentives to move to the hinterlands of São Paulo State promoting changes in rural areas.

Heterogeneous rural-urban spaces have been consolidated, in which both the highly-developed, industry-driven agro-industry coexist with low-density populations that have less-developed economies, which in turn has shown low productivity in larger agricultural chains.

Despite the intense urbanization process in the MMP, there are many natural areas such as protected forests and water sources with great relevance to the region's development and its population. On the other hand, agricultural activities have played an important role that range from recreational areas, income generation, environmental education to nature preservation and food production.

Thus, when thinking about land use in a macro-metropolitan context and the configuration of its urbanization dynamics, as is the case of MMP, it is necessary to incorporate new instruments that are capable of encapsulating the various dimensions of these spaces in their metamorphoses. Moreover it is necessary to assess the impact these metamorphoses have on the land over time as well as to review the current criteria from which the boundaries between these spaces – rural and urban – were determined.

These tools should allow the combination and integration of large volumes of data at different scales from different sources and can be represented in different contexts. Given the multiplicity of spatial data, Geographic Information Systems (GIS) and its analysis tools allow for the production, organization and complex combinations of data in varied scales, as well as map design and thematic cartography. GIS, together with the thematic cartography produced by it, are the tools of analysis included in the characterization of MMP spaces and indication of their rural areas.

The various sources of data used during the research from which this article is derived include demographic and agricultural censuses and detailed farming data from Lupa/CATI/IEA, among others.

In the Fig. 2 and 3 are included maps that demonstrate Brazil's classification of urban and rural in the MMP. In the maps of Fig. 2, the first map (top left) is the official MMP classification that distinguishes between rural and urban spaces; second (top right) is the "urban spot," meaning the urbanization of this territory; the third (bottom left) illustrates the merge of the first and second maps; and fourth (bottom right) is the result. It is noted, as shown in the last map, that some municipalities are wholly classified as urban spaces.

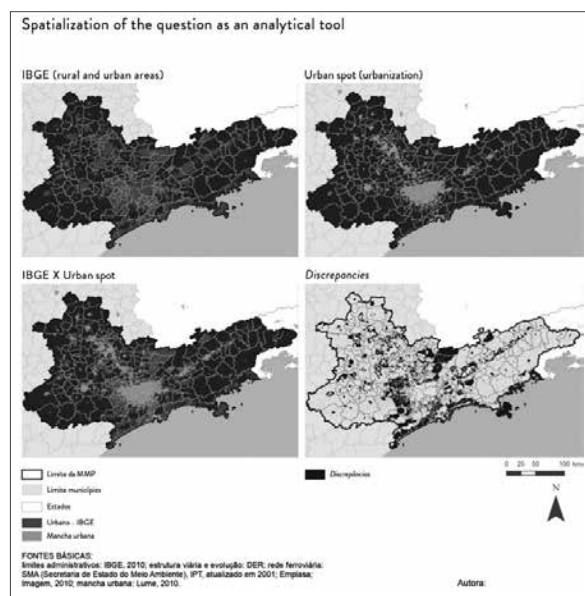


Fig.3 Spatialization of the question as an analytical tool

Among some of the differences found between the official Brazilian classification and the urbanized areas identified through the urban spot, three (3) examples were selected and characterized with regard to social and economic aspects in order to confirm or refute the boundaries of their rural and urban areas: São Paulo, Piracaia and Joanópolis.

Even though new rural zones of São Paulo city defined by the PDE 2014, to some extent, correspond to what the Brazilian Institute of Geography and Statistics (IBGE) classify as rural areas of this territory (like the north of the municipality), the IBGE defines this area to the north as clearly urban areas. It is true that there is intense urbanization pressure in these areas, but it has not yet been totally occupied by urban sprawl as suggested by IBGE classification and still preserves fragments of the Atlantic forest, as shown in Fig. 3, that are protected by law.

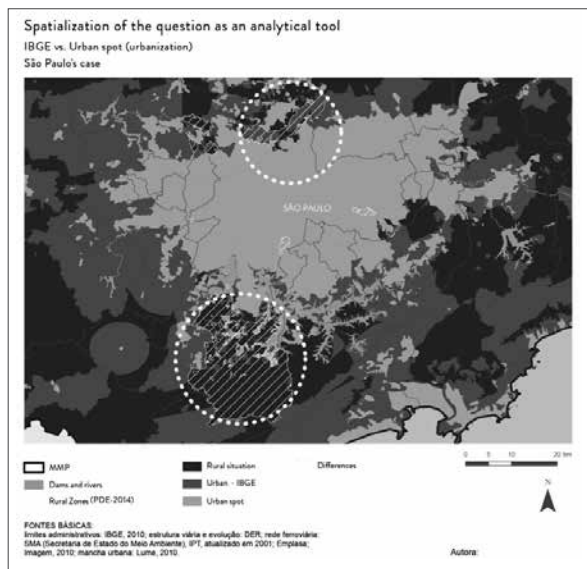


Fig. 4 Spatialization of the question as an analytical tool – IBGE vs. Urban spot (urbanization). São Paulo's case.

There was a decline in the number of establishments and employed persons in agricultural activities between the latest Agricultural Census (1996 and 2006) despite the area has been growing, while in the Lupa/CATI/IEA (2007-2008) survey there are 253 Agricultural Production Units (APUs) in the municipality of São Paulo and they occupy 2,936 hectares, which is approximately 2% of its territory. In these units, in addition to agricultural activities, there are also commercial activities and services such as restaurants and other leisure activities. It is also important to note that the population of the São Paulo municipality in 2010 was 11,253,503 inhabitants and it has an average population density of approximately 7,398.26 inhab./km². That is, a big population with high density levels is attributed to urban areas.

Another and different situation is observed in the Piracaia and Joanópolis municipalities. These two municipalities have small population low densities and are predominately occupied by agricultural activities.

Piracaia is a municipality with 25,116 inhabitants and a demographic density with roughly 65.15 inhab./km² (IBGE, 2010). Even more, there are 951 APUs with farmer activities like animal husbandry and agriculture, but also rural-touristic activities, artisanal production, and restaurants. However, the IBGE classification had defined this municipality as completely “urban” space as can be observed in Fig 5.

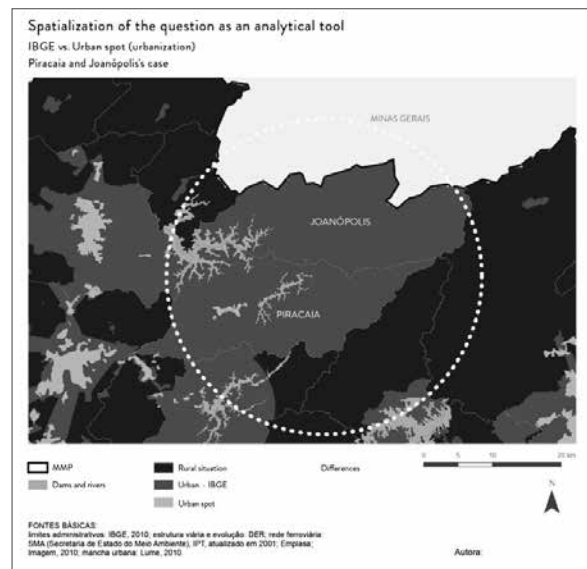


Fig. 5 Spatialization of the question as an analytical tool – IBGE vs. Urban spot (urbanization). Piracaia and Joanópolis's

The graphic in Fig. 6 shows the different types of occupation in non-urban areas of Piracaia municipality. As can be seen, approximately 77% of its territory is agricultural spaces.

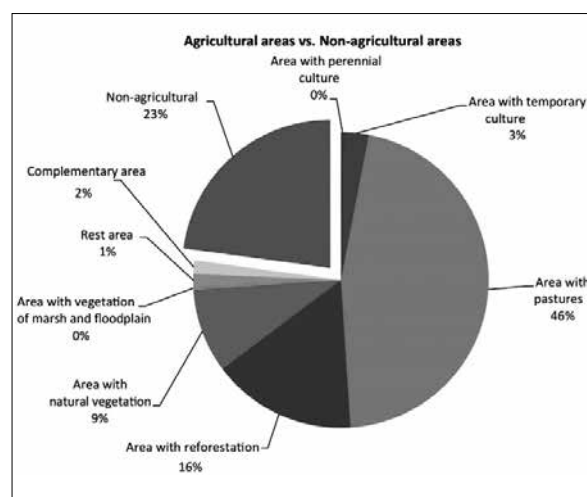


Fig.6 Agricultural and non-agricultural areas from Piracaia

Similarly, in Joanópolis' case the population is approximately 11,768 and the demographic density is 31.44 inhab./km², according to IBGE (2010). There are 1,041 APUs, according to Lupa/CATI/IEA (2007-2008). In addition to the previously mentioned activities for Piracaia include country hotels, hostels, restaurants and snack bars, also contribute to the local economy found in these units. Only 7% of this territory is considered non-agricultural area according to Lupa/CATI/IEA (2007-2008), and the agricultural areas are predominately occupied by pasturelands, as can be seen above (Fig. 6).

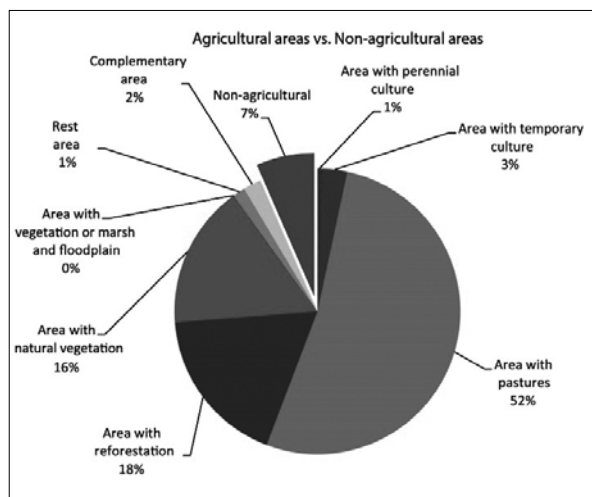


Fig.7 Agricultural and non-agricultural areas from Joanópolis

Other data that can help the analyses over the MMP territory about rural spaces is the number of working-age population and the Gross Domestic Product (GDP). It is possible to observe in Fig 8 that Piracaia and Joanópolis are found in the lower ranges of values which mean less relevance to the greater economy.

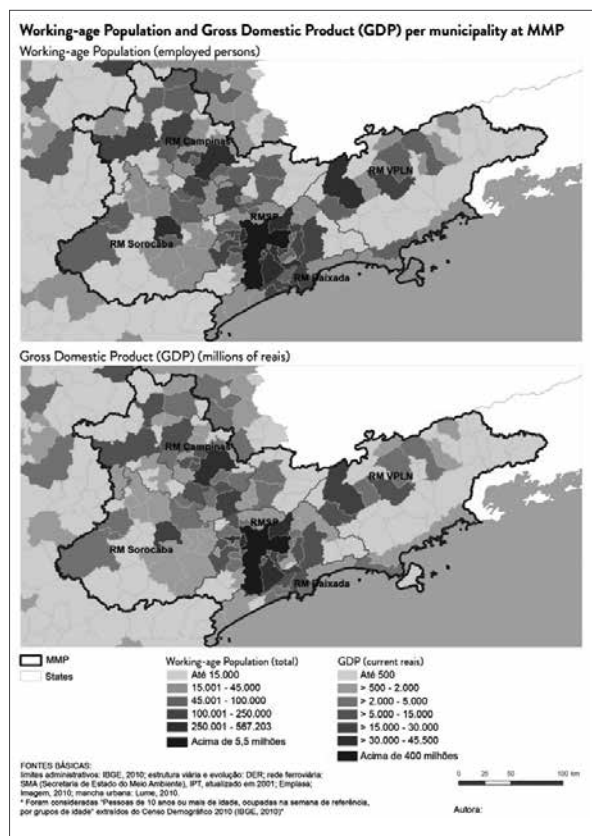


Fig.8 Working-age Population and Gross Domestic Product (GDP) per municipality at MMP

The variables analyzed in this article and the corresponding research are concerned with different types of institutional sources and consequently are frequently linked with incompatible territorial

divisions that demand efforts for possible comparisons and collaboration in the future. The GIS tools offer several resources that can help to organize and manage a great volume of data. The results demonstrate the relevant contribution of these analysis tools as a territory learning feature on different scales and complexity that reveal the relationship established between different and multiple aspects on studies and research in public policy definitions.

Despite this problem, it is possible to introduce many others tools such as the Self-Organizing Map (SOM), which is based on a neural network algorithm capable of working with many variables in many different territorial divisions that can build a map as a gradient from rural to urban and as a hypothesis through which the rigidity of the delimitation of rural-urban could be dissolved.

In this sense, an important challenge when thinking about cross-country research such as in view of the cultural and socioeconomic differences between Brazil and Japan, refers to understand and making database compatible in both contexts to be studied.

Furthermore, these tools and its products have also been used in the dissemination of these results and in the experience of its applicability in diverse territories through the use of Geographic Information Systems on the internet, which can assist in the collective construction of maps and data sharing, debates and analyzes on them and dissemination of results.

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